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HOSPITAL TECHNICAL MEMORANDUM

SAFETY CODE FOR HIGH VOLTAGE INSTALLATIONS

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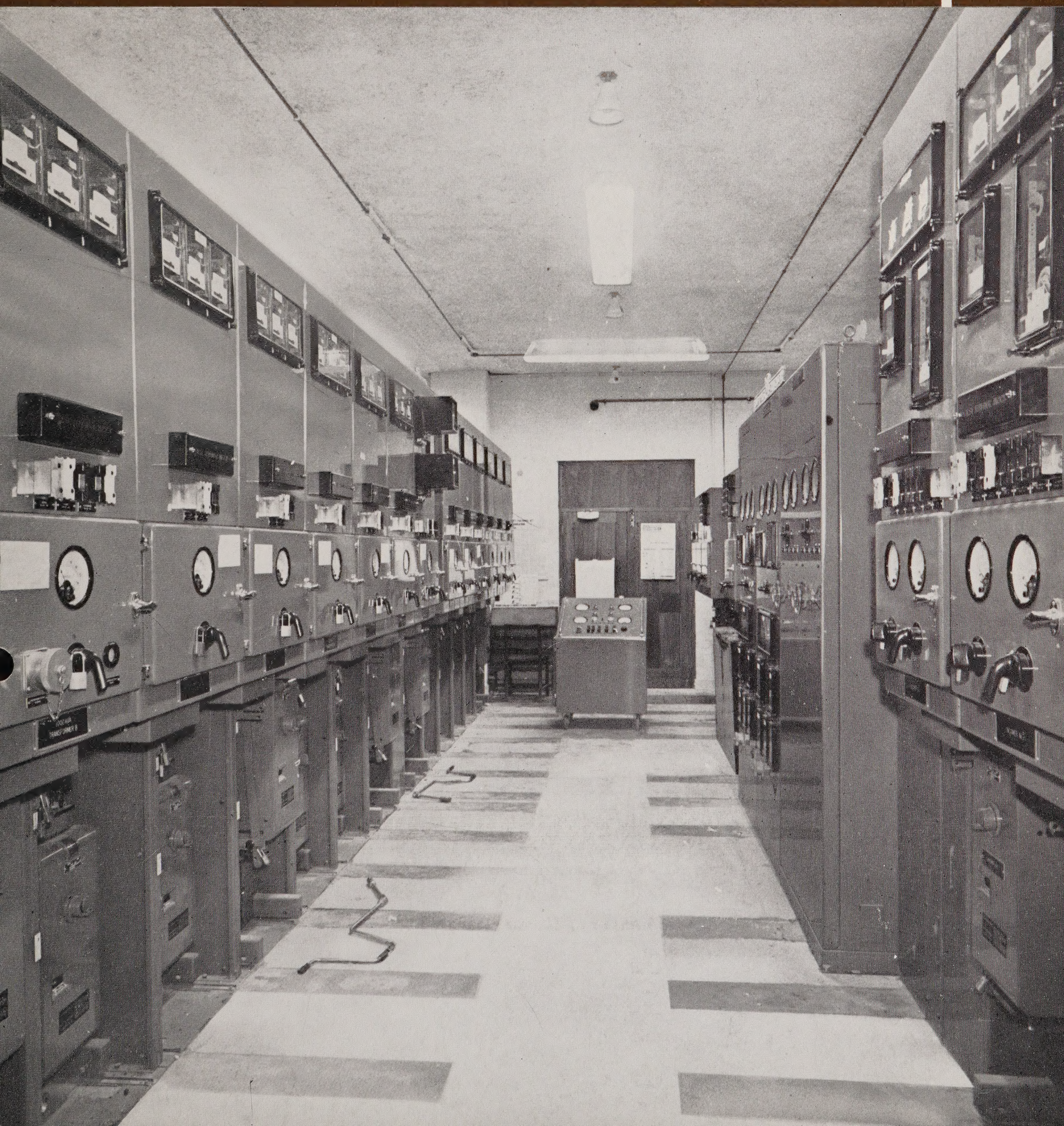

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Hospital Technical Memorandum Number 21

Safety Code for High Voltage Installations

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Front cover picture features Main H.V. Sub-station of Greenwich District Hospital (photograph by courtesy of Electrical Review).

I. Scope

1. This Technical Memorandum gives guidance on the safe operation and maintenance of high voltage electrical distribution systems. Attention is drawn to the relevant clauses of the Electricity (Factories Act) Special Regulations 1908 and 1944. The Memorandum makes recommendations for the allocation of duties to personnel and the manner in which these duties should be performed. The Appendices include reproductions of a Rule book, Permit-to-work, Log-book and H.V. Safety Regulations Poster which are essential components of a H.V. safety organisation.

II. Introduction

2. High voltage electrical systems within hospital complexes come within the provision of the Electricity (Factories Act) Special Regulations 1908 and 1944, (see Appendix 1). Hospital Management Committees or Boards of Governors as occupiers have responsibility for ensuring that the relevant Regulations are complied with. Because of the specialised nature of the risks, it is important that a carefully prepared organisation exists for dealing with routine servicing of H.V. installations and with any emergencies that arise.

3. This Memorandum is primarily concerned with the safe operation and maintenance of H.V. equipment but it is equally important that the H.V. equipment installed complies with the appropriate British Standards and has been satisfactorily tested. It is also important that accurate "as fitted" drawings of H.V. installations are available to those responsible for its operation and servicing.

4. Switchgear, etc. should be standardised as far as practicable to reduce variety and facilitate easier servicing. Most manufacturers produce special attachments to facilitate servicing and testing; these should be purchased with the equipment and placed with other safety equipment in the charge of the Senior Authorised Person. A list of recommended safety equipment is given in Appendix 6.

III. Definitions

5. The following definitions apply throughout this Technical Memorandum and Appendices. It should be noted that the Rule Book, Appendix 2, includes the same definitions.

(i) **High voltage (H.V.)**

The existence of a potential difference (r.m.s. value for a.c.) normally exceeding 650 volts, whether between conductors or between any conductors and earth.

(ii) **Medium voltage (M.V.)**

The existence of a potential difference (r.m.s. value for a.c.) normally less than 650 volts but more than 250 volts whether between conductors or between conductors and earth.

(iii) **Control Engineer**

An engineer employed by an Electricity Board to control that Board's switching operations.

(iv) **Authorising Engineer**

An engineer nominated to advise concerning the safety arrangements of high voltage installations at hospitals and to assess the suitability of candidates to be Authorised Persons.

(v) **Senior Authorised Person**

Person appointed by the hospital authority to be an Authorised Person and to control the high voltage activities of other Authorised Persons.

(vi) **Authorised Person**

A person over 21 years of age possessing adequate technical knowledge and appropriately trained, appointed in writing by the hospital authority to carry out specific operations and/or work on high voltage systems or apparatus.

(vii) **Competent Person**

Normally an electrical craftsman having sufficient technical knowledge, training and experience to enable him, under the supervision of an Authorised Person, to carry out maintenance work and modifications on high voltage systems and understand fully the dangers involved.

(viii) **Permit-to-work/test**

A form of declaration signed by an Authorised Person defining the switching operations and other safety measures which have been taken and detailing work or tests to be carried out on high voltage apparatus. Hereinafter referred to as a Permit-to-work.

(ix) **Sub-station**

A room or enclosure containing one or more high voltage transformers and/or high voltage switchgear. In some instances transformers and switchgear may form a composite unit.

(x) **High voltage enclosure, cell or compartment**

An enclosure containing exposed 'live' high voltage conductors, or apparatus, or parts thereof

(xi) **Circuit main earth**

An earthing connection applied by the Authorised Person before a Permit-to-work is issued.

(xii) **Mimic Diagram**

A permanently displayed single line diagram showing the complete high voltage distribution at the hospital and having facilities for altering the switch and circuit breaker symbols to show whether each such unit is closed, open or earthed. Medium voltage circuits which can feed back to the high voltage circuits are also shown.

(xiii) **Key locker**

An enclosure, usually forming part of the Mimic Diagram cabinet and containing all keys associated with the safety of the high voltage installation. (The enclosure should be kept locked and the keys to the lock should normally be available only to Authorised Persons).

(xiv) **Key safe**

A small portable box for housing the safety keys of an installation whilst work on the installation is in progress, when more than one Authorised Person or Permit holder is involved. (The lid of the box should have facilities for three separate clasps and padlocks.)

(xv) **'Danger' notice**

A notice at least 250 mm. x 120 mm., made of electrical insulating material having a white background with the word DANGER shown in red. (The letters should be at least 70 mm. high. Each notice should have a suitable loop affixed for padlocking to switchgear, etc.).

(xvi) **'Caution' notice**

A notice as above, but having the word CAUTION in black letters on a yellow background.

(xviii) **Log-book**

A pro-former log-book in which all switching operations, precautionary work prior to the issue of a Permit-to-work, and unusual occurrences should be recorded. (It should be kept in the Mimic Diagram cabinet).

IV. Safety Organisations

6. Hospital Management Committees or Boards of Governors are responsible for the safety of H.V. systems on their premises. The operation and servicing of H.V. equipment should be entrusted only to persons who are technically competent and appropriately trained. These will be nominated as Authorised or Competent Persons. There should be a properly prepared programme for dealing with routine servicing and any emergencies that arise.

7. Within the hospital Group's general engineering structure a Senior and at least one other Authorised Person should be nominated for each hospital having a H.V. installation. Where there are difficulties in providing sufficient suitable staff to provide a twenty-four hour coverage, adjacent hospital authorities should pool their staff resources to provide a panel of Authorised Persons for each H.V. installation. Arrangements should be made to enable these officers to be contacted at their homes and details of their names, addresses and means of contact should be maintained at the hospital's telephone switchboard. Pooling arrangements should be approved by the Authorising Engineer.

Appointment of Authorised Persons

8. It is important that only persons having the necessary technical knowledge, training and experience are nominated as Authorised Persons. A member of the Regional Engineer's staff, preferably a chartered electrical engineer, should be nominated as the Authorising Engineer for the purpose of assessing the suitability of candidates to be nominated as Authorised Persons and assisting generally H.M.C.'s on matters associated with H.V. installations. Boards of Governors should also nominate a member of their staff as the Authorising Engineer having special responsibility for the H.V. installations at the Board's premises.

9. Hospital authorities should aim to become independent in respect of the operation and servicing of their H.V. installations by recruiting and training suitable staff for the purpose. Attention is drawn to Appendix 5, which deals with training.

10. Where hospital authorities do not have suitable staff it will be necessary as an interim measure to make alternative arrangements for servicing H.V. equipment, i.e. by using the services of an Area Electricity Board or other suitable contractors or for Regional Hospital Board staff to be nominated until other suitable members of the hospital authorities own staff are appointed or trained. In these instances it would still be necessary to appoint Authorised Persons to deal with switching operations; the persons concerned should receive adequate training.

Duties of Senior Authorised Persons

11. Within the overall management responsibilities of the H.M.C. or B.G. the duties of the Senior Authorised Persons may be summarised as follows:

(*a*) Control the activities of Authorised Persons in respect of work on H.V. systems, prepare an inspection and maintenance programme and progress the work.

(*b*) Ensure that all records concerning H.V. systems are kept up-to-date.

(*c*) Ensure that test equipment is maintained in good condition.

(*d*) Co-operate with the Authorising Engineer in matters of policy concerning H.V. installations.

(*e*) Report any unusual occurrences to the Authorising Engineer.

(*f*) Act as Authorised Person for installations allocated to him.

(*g*) Ensure that the necessary safety posters are displayed in sub-stations at all times.

Duties of Authorised Persons

12. Within the overall management responsibilities of the H.M.C. or B.G., the responsibilities of an Authorised Person are stated below:

(*a*) Act as Authorised Person for those installations allocated to him.

(*b*) Issue and cancellation of Permits-to-work.

(*c*) H.V. switching operations.

(*d*) Routine inspection and testing of sub-station earthing.

(*e*) Routine inspection and testing of transformers and H.V. switchgear.
(*f*) Routine inspection and testing of H.V. protection systems.
(*g*) Report any unusual occurrences to the Senior Authorised Person.

Permit-to-work Systems

13. There should be a properly instituted system whereby all work on H.V. equipment, or work which could be dangerous because of the close proximity of H.V. equipment, including H.V. cables is controlled by the issue of a Permit-to-work by an Authorised Person and that the work is carried out by Competent Persons—see definition above. Appendix 3 gives details of a Permit-to-work.

14. No person should work alone whilst work/testing is in progress on or any danger exists from H.V. equipment.

Rule Book

15. All employees concerned with the operation or work on electrical installations should be provided with a personal copy of the Rule Book for High Voltage Systems and be required to sign for its receipt.

16. The rules and a form of receipt are set out in Appendix 2.

Safety Equipment

17. Equipment to facilitate the safe operation and servicing of H.V. systems should be readily available to Authorised Persons. This should include:

(*a*) A Mimic Diagram (see Appendix 4).
(*b*) A complete set of numbered safety locks and keys and Key locker complete with easily identifiable key bunches for each H.V. distribution centre. There should be no duplicate keys. The Key locker is usually arranged to form part of the Mimic Diagram cabinet (see Appendix 4).
(*c*) A key safe to accommodate the appropriate safety keys whilst work is in progress.
(*d*) A Log-book for recording all switching operations, safety precautionary measures, repairs and any ususual occurrences concerning the H.V. system, (see Appendix 8).
(*e*) Printed pads of Permits-to-work with serial numbers (see Appendix 3).
(*f*) The following safety posters which should be permanently exhibited in each sub-station:
  (i) Electricity (Factories Act) Special Regulations 1908 and 1944.
  (ii) Resuscitation poster showing mouth-to-mouth and Holger Nielsen methods for electric shock treatment.
  (iii) The Department of Health and Social Security High Voltage Safety Regulations (see Appendix 7).
(*g*) Testing, earthing equipment, etc., for the use of authorised personnel. A full list of recommended safety equipment is listed in Appendix 6.

Reporting of Accidents

18. Any accident involving injury to personnel or damage to equipment should be reported to the Regional Hospital Board or Board of Governors within 48 hours. Accidents involving injury should also be reported to H.M. Factory Inspectorate within 72 hours.

19. Each incident should be investigated by a Senior Group Officer, to establish the facts and to consider what measures, if any, are necessary to improve the safety arrangements.

Security and admittance to Sub-stations

20. All doors to all sub-stations should be marked DANGER HIGH VOLTAGE. All sub-stations should be kept locked, the locks being identical so that a single key will enable access to be gained to any sub-station. Each Authorised Person should be issued with a key, and for emergency use an additional key should be kept in a "break-glass" fronted box at a constantly manned part of the hospital, e.g. the telephone exchange. A log-sheet should be provided in the key box, together with instructions to the effect that before taking the key a person should first enter his name on the log-sheet and state the reason for which the key is required. No person should be allowed to enter a sub-station unless he is, or is accompanied by, an Authorised Person or a Competent Person.

Routine Servicing

21. High voltage equipment should be regularly inspected, serviced and tested to ensure that it is maintained in a safe and serviceable condition. The Permit-to-work system should be used to cover the work and a record of all operations should be kept in the log-book. The recommended frequency of inspections, etc. is as follows:

(*a*) ***Transformers and switchgear***
At 2-yearly intervals the equipment should be completely isolated from the H.V. and M.V. mains and thoroughly inspected, special attention being given to the condition of switching contacts, insulation and moving parts. Oil samples from each oil-cooled transformer and oil switch or circuit breaker should be sent to a competent authority for testing whether the insulating properties are suitable for the oil to continue in service. Switchgear should be operated at intervals as recommended by the makers.

(*b*) ***H.V. protective systems***
Check the relay settings and fuses of the protective systems at 6-monthly intervals.
At 2-yearly intervals, protective systems should be thoroughly inspected and tested, including secondary injection tests, to ensure they are functioning correctly.
Battery maintenance should be dealt with in accordance with the usual preventive maintenance schedule.

(*c*) ***Sub-station earthing***

The main earthing continuity conductors and connections should be inspected at 6-monthly intervals, special attention being given to the more vulnerable parts such as the final connecton to earth electrodes and other external parts of the earthing system.

The earthing systems should be tested annually using a heavy current test method.

(*d*) ***Fire extinguishing installations and equipment***

Inspections and checks should be made as recommended in Appendix 3 of Hospital Technical Memorandum No. 16, Fire Precautions (revised 1969).

CO_2 notices at all entrances to sub-stations fitted with CO_2 equipment should be satisfactorily maintained.

First-aid and Treatment for electric shock

22. All persons likely to work on H.V. installations should receive instruction in first aid and practice these measures, particularly the methods of treating persons suffering from the effects of an electric shock.

Appendix 1.

Statutory Requirements

1. The Electricity (Factories Act) Special Regulations 1908 and 1944 include the following regulations which are relevant to safe operation of H.V. electrical installations:

"Regulation 18

In every SWITCHBOARD for HIGH PRESSURE or EXTRA HIGH PRESSURE:

(*a*) Every HIGH PRESSURE and EXTRA HIGH PRESSURE CONDUCTOR within reach from the working platform or in any SWITCHBOARD PASSAGE-WAY shall be so placed or protected as adequately to prevent DANGER.

(*b*) The metal cases of all instruments working at HIGH PRESSURE or EXTRA HIGH PRESSURE shall be either EARTHED or completely enclosed with insulating covers.

(*c*) All metal handles of HIGH PRESSURE and EXTRA HIGH PRESSURE switches and, where necessary to prevent DANGER, all metal gear for working the switches, shall be EARTHED.

(*d*) When any work is done on any SWITCHBOARD for HIGH PRESSURE or EXTRA HIGH PRESSURE the SWITCHBOARD shall be made DEAD unless:

(1) The section of the switchboard on which the work is done (hereinafter referred to as "The Relevant Section") is made DEAD and every other Section which is ALIVE is either (i) so separated from the Relevant Section by permanent or removable divisions or screens as not to be a source of DANGER to persons working on the Relevant Section, or (ii) in such a position or of such construction as to be as safe as if so separated as aforesaid: or

(2) The SWITCHBOARD itself is so arranged as to secure that the work is done without DANGER without taking any of the precautions aforesaid."

"Regulation 28

No person except an AUTHORISED PERSON or a Competent Person acting under his immediate supervision shall undertake any work where technical knowledge or experience is required in order adequately to avoid DANGER: and no person shall work alone in any case which the Secretary of State directs that he shall not. No person except an AUTHORISED PERSON, or a Competent Person over 21 years of age acting under his immediate supervision shall undertake any repair, alteration, extension, cleaning, or such work where technical knowledge or experience is required in order to avoid DANGER, and no one shall do such work unaccompanied. Where a contractor is employed, and the DANGER to be avoided is under his control, the contractor shall appoint the AUTHORISED PERSON, but if the DANGER to be avoided is under the control of the occupier, the occupier shall appoint the AUTHORISED PERSON."

"Regulation 29

Instructions as to the treatment of persons suffering from electric shock shall be affixed in all premises where electrical energy is generated, transformed, or used above LOW PRESSURE; and in such premises, or classes of premises, in which electrical energy is generated, transformed, or used at LOW PRESSURE as the Secretary of State may direct."

"Regulation 30

Every SUBSTATION shall be substantially constructed and shall be so arranged that no person other than an AUTHORISED PERSON can obtain access thereto otherwise than by the proper entrance, or can interfere with the APPARATUS or CONDUCTORS therein from outside: and shall be provided with efficient means of ventilation and be kept dry."

"Regulation 31

Every SUBSTATION shall be under the control of an AUTHORISED PERSON and none but an AUTHORISED PERSON or a person acting under his immediate supervision shall enter any part thereof where there may be DANGER."

"Regulation 32

Every underground SUBSTATION not otherwise easily and safely accessible shall be provided with adequate means of access by a door or trap-door with staircase or ladder securely fixed and so placed that no LIVE part of any SWITCHBOARD or any BARE CONDUCTOR shall be within reach of a person thereon: providing however that means of access to such SUBSTATION shall be by a doorway and staircase (*a*) if any person is regularly employed therein, otherwise than for inspection or cleaning or (*b*) if the SUBSTATION is not of ample dimensions and there is therein either moving machinery other than ventilation fans, or EXTRA HIGH PRESSURE."

Appendix 2

Department of Health and Social Security Welsh Office

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RULE BOOK FOR HIGH VOLTAGE SYSTEMS

1

Appendix 2 of Hospital Technical Memorandum No. 21

SERIAL NO. 0343

SAFETY RULES FOR HIGH VOLTAGE SYSTEMS*

This Rule Book is the property of.....

.....Regional Hospital Board/Hospital Management.....

Committee/Board of Governors and is issued to Mr.....
being an Authorised/Competent Person within the meaning of the Electricity (Factories Act) Special Regulations 1908 and 1944 to undertake work on high voltage installations. This rule book shall not be transferred to any other person and shall be returned to the R.H.B./H.M.C./B.G. on his ceasing to be an Authorised/Competent Person.

Signed.....

Authorising Officer

RECEIPT (when produced as a separate document this part will be perforated to facilitate removal).

.....R.H.B./H.M.C./B.G. Copy No. 0343

I accept the responsibilities of an Authorised/Competent Person as outlined in these rules.

Signed.....

Signature of Authorised/Competent Person

Date .....

*Copies of the Rule Book will be serially numbered and available separately in pocket-book form for each Authorised and Competent Person.

CERTIFICATE OF AUTHORISATION

Mr....., has satisfied the undersigned that he understands these Safety Rules, and that he is able to undertake the duties of an Authorised/Competent Person at:

.....

.....

.....

.....

.....

.....

.....

(Enter above the names of only those premises in which there is an H.V. System and for which the named person is authorised).

Signed.....

(Signature of Authorising Engineer/Authorised Person)

NOTE: Authorising Engineers shall sign on behalf of Authorised Persons and Authorised Persons shall sign on behalf of Competent Persons.

Date .....

Definitions

1. When the safety rules are produced as a separate document the definitions set out in Section III will be included. (Definitions shall be construed as having the same authority as the remainder of the Rule Book.)

Application of rules

2. The rules are applicable to all parts of a high voltage system including switchgear, high voltage cables, transformers and medium voltage switchgear and cables up to and including the first isolation point.

Security of high voltage sub-station, enclosures, etc.

3. All substations shall be kept locked when unattended.

4. No person other than an Authorised Person shall enter a room containing high voltage equipment unless accompanied by an Authorised Person or covered by a Permit-to-work issued by an Authorised Person, except in an emergency (see paragraphs 13 and 23).

Safety keys

5. Each Authorised Person shall be issued with a personal key to enable him to gain access to all sub-stations and also a key to the Key locker and Mimic Diagram cabinet. A spare of each of these keys is located in a "break-glass" fronted box at.....
..... (insert location) for emergency use only. Should the spare keys be required, the person concerned should enter his name on a log-sheet to be kept in this key box and give the reason for requiring the key.

6. All other keys to the safety locks associated with the high voltage system shall be kept in the Key locker when not in use, unless a key safe is being used. The keys for each distribution centre shall be kept in a separate clearly labelled bunch. No spare keys shall be provided elsewhere.

7. The Key locker shall be kept locked except when keys are being removed from or returned to it, and it is important that the Key locker is kept locked when work is in progress to prevent unauthorised removal of keys.

8. A key safe shall be provided to house the safety keys associated with the work, when more than one Authorised Person or Permit holder* is concerned. The key safe shall be secured by the personal padlock of each Authorised Person concerned. For this purpose each Authorised Person shall be issued with a padlock and key. There shall be no duplicate keys.

*These may be Permit-to-work holders employed by contractors.

Safety posters

9. The following shall be displayed in each sub-station:

(*a*) Electricity (Factories Act) Special Regulations 1908 and 1944.

(*b*) Resuscitation poster showing mouth-to-mouth and Holger Nielsen methods of treatment for electrical shock.

(*c*) The Department of Health and Social Security High Voltage Safety Regulations.

Authorisation and supervision of work

10. No work shall be carried out in a sub-station or elsewhere where there is any risk due to the close proximity of high voltage equipment including cables, unless authorised by a Permit-to-work.

11. All such work shall be under the direct supervision of the Competent Person named on the Permit. No person shall work alone.

Safety preparations for work

12. Before issuing a Permit-to-work, the Authorised Person shall:

(*a*) Ensure that the Competent Person to whom it will be issued is fully conversant with the high voltage system and the nature of the work to be done.

(*b*) Record in the Log-book details of the switching operations and other safety measures he intends to carry out to make the system safe to work on.

(*c*) Alter the Mimic Diagram to show the exact state the switches and circuit earths will be after he has made the system safe to be worked on.

(*d*) Display the "Work on H.V. system in progress" notice on the Mimic Diagram cabinet.

(*e*) Carry out the switching operations, test the conductors to be worked on to ensure they are 'dead' and apply circuit main earths.

(*f*) Fix DANGER and CAUTION notices, fences and barriers to make work site safe.

Action in an emergency

13. Authorised Persons shall go firstly to the Mimic Diagram cabinet. The first one on site shall display the "Work on H.V. system in progress" notice before taking any action to deal with the emergency. Any other Authorised Person attending the site on seeing this notice shall take no action until he has contacted the Authorised Person who displayed the notice.

Procedure for issue of Permit-to-work

14. The Authorised Person shall enter on the Permit-to-work full details of the precautions which have been taken to make the equipment safe. He shall also write on the Permit the exact details of the work to be carried out.

15. The top copy of the Permit-to-work shall be issued to the Competent Person in charge of the work, who

after reading its contents and signifying to the Authorised Person that he fully understands the instructions etc., shall acknowledge its receipt by signing the duplicate copy.

16. The receipient of the Permit-to-work shall retain the top copy in his possession at all times whilst the work detailed on the Permit is being carried out.

17. Where more than one working party is concerned, a Permit-to-work shall be issued to the Competent Person in charge of each working party and the fact that other Permits are in use at the same time shall be indicated on each Permit, giving the serial numbers.

18. If, during the course of the work, it is found necessary to change the scope of the work, the existing Permit-to-work shall be returned to the Authorised Person and cancelled and a new Permit-to-work issued, clearly detailing the revised work.

19. Carbon copies shall not be removed from the Permit-to-work book even when a Permit-to-work is cancelled before issue.

Procedure for cancelling Permits-to-work

20. When work for which a Permit-to-work has been issued is suspended or completed, the Competent Person to whom it was issued shall sign the 'Clearance' section and return the Permit-to-work to the Authorised Person who shall destroy it in the presence of the Competent Person.

21. Where more than one Permit-to-work has been issued for work on high voltage apparatus associated with the same circuit main earths the Authorised Person shall ensure that all such Permits-to-work have been cancelled before the circuit main earths are removed.

Reconnection of supply

22. On satisfactory completion of the work detailed on the Permit-to-work, the Authorised Person shall record in the Log-book, the procedures he intends to carry out, including removal of circuit main earths, DANGER notices, etc., and the switching operations necessary for the reconnection of the supply. He shall alter the Mimic Diagram before carrying out the switching operations to reinstate the supply, and shall verify afterwards that the Mimic Diagram is a true record of the system.

Operation of switchgear

23. High voltage switching shall be carried out by an Authorised Person or by a Competent Person acting under his immediate supervision except to isolate in an emergency, when a Competent Person will have access to sub-stations where emergency tripping facilities are available. These circuit breakers will be fitted with locks preventing unauthorised re-closure. The Authorised Person shall be informed of all high voltage emergency switching.

24. Locks shall be applied as necessary to prevent unauthorised operation of switchgear (except emergency tripping as referred to above).

25. Circuit breakers and fuse switches shall in general be re-closed once only after opening under fault conditions. The equipment shall be inspected at the first opportunity after opening under fault conditions.

26. Making 'live' or 'dead' by visual signal or pre-arranged understanding after an agreed interval of time, is forbidden.

CAUTION and DANGER notices, barriers, etc.

27. CAUTION notices shall be fixed (by padlocks) to the control mechanism of all switchgear which has been made 'dead' (locked off) to enable work to proceed. DANGER notices shall be attached (by padlocks) on or adjacent to 'live' apparatus as necessary, at the limit of the zone in which the work may be carried out. CAUTION and DANGER notices, barriers and screens shall be fixed and moved only under the supervision of the Authorised Person.

Earthing

Circuit main earths

28. The following procedure shall be observed when high voltage apparatus is to be discharged and earthed.–

(*a*) Where practicable, the circuit breaker or specially provided earth switch shall be used to make the earth connection. Where a circuit breaker is used the manual trip feature shall be rendered inoperative before closing, unless this is impracticable. After closing, the circuit breaker or earth switch shall be locked in the earthed position, whilst it is the circuit main earth.

(*b*) Where (*a*) is not practicable, the high voltage apparatus shall be tested to ensure that it is 'dead' and shall then be discharged and earthed by an earthing lead applied by means of a pole or other approved method in accordance with para. 32.

Earthing leads and connections

29. Earthing leads and associated clamps shall be examined immediately prior to use and shall be of adequate capacity to carry the prospective fault current of the system at the point of application. They shall be properly stored and maintained.

Operation of earthing switches

30. No high voltage earthing switch shall be operated or circuit main earth connection attached or removed except by the Authorised Person.

Recording of circuit main earths

31. The precise location of each circuit main earth shall be recorded on the Permit-to-work.

Procedure for the use of earthing leads

32. The following procedure shall be observed when using earthing leads:

(*a*) Verify that the circuit is 'dead' by means of a voltage indicator of approved type, the indicator itself being tested immediately before and after the verification.

(*b*) Earthing leads shall be connected to the earth system before being secured to phase conductors. They shall be secured to the phases only by means of a pole or other approved apparatus. Care must be taken to ensure that good contact is made.

(*c*) All phases shall be earthed, even if work is to be carried out on one phase only.

(*d*) Earthing leads shall not be applied in any cell or compartment in which there is any exposed metal 'live' at high voltage.

(*e*) When earthing leads are being removed, they shall be disconnected from phase conductors first and the earth system last.

(*f*) The manufacturers' earthing equipment only shall be used for the purpose of earthing spouts contacts of switchgear. The insertion of the hand or any tool in contact spouts for this purpose is forbidden.

Testing of high voltage apparatus

33. When any high voltage apparatus is to be subjected to a test voltage before being connected to the high voltage systems, a Permit-to-work shall be issued by the Authorised Person who although not carrying out the work himself shall ensure that such apparatus and all circuitry which may become 'live' when the test voltage is applied is adequately guarded, or that barriers are erected to form a test enclosure with DANGER notices fixed in conspicuous positions at all approaches to the test area during the period the apparatus may be subject to high voltage.

34. All cables shall be discharged before and after the application of test voltage.

35. Temporary conductors used for testing purposes shall be of an adequate size and easily visible and identifiable.

36. For test connections to spout contacts, test bushes as supplied by the switchgear maker shall be used. Test connections shall not be applied in a cell or compartment in which there is any exposed metal 'live' at high voltage. (This rule does not exclude the use of approved voltage indicators, or approved devices for testing and phasing out circuits).

Work on remotely and automatically controlled equipment

37. Before work is carried out on remotely or automatically controlled equipment such as circuit breakers, isolators, tap changing gear, or associated air compressors, all remote control and automatic features shall first be rendered inoperative. No work shall be carried out on the controlling equipment, wiring or relays except by the Authorised Person or Competent Person working under the supervision of the Authorised Person.

Work on busbar spouts or multi-panel switchboards

38. When work is to be carried out on busbar spouts, the following operations shall be carried out in strict sequence:

(*a*) The authorised Person shall enter details of necessary safety precautions and switching operations in the Log-book and alter Mimic Diagram.

(*b*) The section of the busbar spouts on which work is to be carried out shall be isolated from all points of supply from which it can be made 'live'.

(*c*) The isolating arrangements shall be locked so that they cannot be operated, and shutters of 'live' spouts locked shut. CAUTION notices shall be fixed to the isolating controls.

(*d*) Busbars shall be checked by means of an approved voltage indicator to verify that they are 'dead', the indicator itself being tested immediately before and after the verification. The checking with the voltage indicator shall be done on the panel to which the circuit main earths are to be applied. This test shall also be made on the panel on which the work is to be carried out.

(*e*) Circuit main earths shall be applied at a panel on the isolated section of the busbar other than that at which work is to be done, using the method recommended by the switchgear manufacturers.
The insertion of the hand or any tool into contact spouts for this purpose is forbidden.

(*f*) An earth shall also be applied to all phases at the point of work.

(*g*) Where applicable, DANGER notices shall be attached on or adjacent to the 'live' apparatus at the limits of the zone in which work may be carried out.

(*h*) The Permit-to-work shall be issued to cover the work to be done. During the course of the work, where applicable the earth at the point of work may be removed one phase at a time. Each phase earth shall be replaced before a second phase earth is removed.

(*i*) On completion of the work, the Permit-to-work shall be cancelled.

(*j*) The Authorised Person shall enter in the log book details of the precautions to be removed and the switching operations which he intends to make to re-instate the supply, and alter Mimic Diagram.

Work on feeder spouts, voltage transformer spouts or single panel busbar spouts

39. When work is to be carried out on feeder or voltage transformer spouts, or on busbar spouts of a single panel, the following operations shall be carried out in strict sequence:

(*a*) The Authorised Person shall enter details of necessary safety precautions and switching operations in the Log-book, and alter Mimic Diagram.

(*b*) The spouts on which work is to be carried out shall be isolated from all points of supply from which they can be made 'live'.

(*c*) The isolating arrangements shall be locked so they cannot be operated, and the shutters of 'live' spouts shall be locked shut. CAUTION notices shall be fixed to all isolating controls.

(*d*) Spout contacts shall be checked by means of an approved voltage indicator to verify that they are 'dead', the indicator itself being tested before and after the verification.

(*e*) The circuit shall be earthed with approved earthing equipment at the point of work and at all points of isolation from the supply. For the purpose of earthing metal-clad switchgear, approved appliances only shall be used. The insertion of the hand or any tools into contact spouts for this purpose is forbidden.

(*f*) A Permit-to-work shall be issued.

(*g*) During the course of the work where practicable the earth at the point of work may be removed one phase at a time, each phase earth being replaced before a second earth is removed.

(*h*) On completion of the work the Permit-to-work shall be cancelled.

(*i*) The Authorised Person shall enter in the Log-book details of the precautions to be removed and the switching operations which he intends to make to reinstate the supply, and alter Mimic Diagram.

Withdrawable apparatus

40. When withdrawable apparatus has been disconnected from all supplies and withdrawn from its normal 'live' position, its conductors shall be discharged to earth but need not remain connected to earth.

Work on transformers

41. When work is to be carried out on the connections to or the windings of a transformer, the switchgear or fusegear controlling all windings shall be opened and locked in this position. The transformer shall be earthed with approved earthing equipment at all points of isolation from high voltage supplies. Additionally, associated voltage and auxiliary transformers shall be isolated to prevent the possibility of the transformers being made 'live' by feed-back. Before a Permit-to-work is issued the Authorised Person shall at the point of work identify and mark the transformer to be worked upon.

42. Where work is to be carried out on a high voltage/medium voltage transformer and the medium voltage windings of the transformer are controlled by a switch or isolator, the switch or isolator shall be locked open, or other physical means shall be used to prevent the switch from being inadvertently closed during the course of work.

43. The transformer shall be isolated from all common neutral earthing equipment from which it may become 'live'. This does not require the disconnection of solidly earthed neutrals or neutral equipment connected solely to the transformer on which work is to be done.

44. CAUTION notices shall be fixed at all points of isolation including those of medium and low voltage.

Work on high voltage cables

45. Before issuing a Permit-to-work for work on high voltage cable, the Authorised Person in addition to the procedure described in para. 27 shall identify and mark the cable to be worked upon. The cable shall then be spiked at the point of work, preferably with a remotely controlled spiking gun.

46. No person shall touch any exposed insulation which covers or supports any conductor on a high voltage system unless the conductor is 'dead' and earthed.

Apparatus which can be made 'live' from an Electricity Board's supply system

47. Except in an extreme emergency, any switching which may affect an Electricity Board's network shall be carried out with the full knowledge and agreement of the Electricity Board Control Engineer concerned. The switching operation shall be recorded by the Authorised Person and the Control Engineer.

48. Switching to the Control Engineer's instructions, or with his consent, shall be carried out without undue delay. All switching, whether to a Control Engineer's instructions or with his consent, or under conditions of emergency shall be reported to the Control Engineer as soon as possible after each operation.

49. Where work is to be carried out on apparatus which is directly connected to an Electricity Board's high voltage mains, then switching, earthing, deposit of safety keys in the key safes and issuing of any Permit-to-work shall be the responsibility of an Authorised Person appointed by the Supply Authority.

Fire protection equipment

Automatic control

50. Before work or inspections are carried out in any enclosures protected by automatic fire extinguishing equipment:—

(*a*) The automatic control shall be rendered inoperative by the Authorised Person and the equipment left on hand-control from within the

sub-station only. A prominent 'turnover' type cautionary notice shall be displayed within the protected area and shall indicate whether or not the automatic fire protection system is operative. This is usually indicated by a system of warning lights.

(*b*) Precautions taken to render the automatic control inoperative shall be noted on any Permit-to-work issued for work in the protected enclosure.

(*c*) The automatic control shall be restored by the Authorised Person immediately after the persons engaged on the work have withdrawn from the protected enclosure.

Portable extinguishers

51. Only CO_2 or dry powder extinguishers shall be used in the vicinity of 'live' electrical apparatus and a safety clearance of at least 0.3m. shall be maintained. After the discharge of portable extinguishers in an enclosed space, personnel shall withdraw from that space until the precautions set out in paragraph 52 have been taken.

General

52. After any explosion or fire, or after the discharge of extinguishers in an enclosed space, the space shall be thoroughly ventilated before entry of personnel, unless suitable breathing apparatus is worn.

Supply failures

53. A failure of supply, from whatever cause, on any part of the high voltage system shall be reported immediately to the Authorised Person and shall be noted in the Log-book. During failures of supply, all apparatus, equipment and conductors shall be regarded as being 'live' until isolated, checked with a voltage indicator and earthed.

Telephone messages

54. Every telephone message relating to the operation of the high voltage system shall be written down and repeated to the sender to ensure that it has been accurately received. Essential details of each message shall be recorded in the Log-book.

Treatment of electric shock

55. All persons who may be concerned with the operation of, or work on, electrical systems shall make themselves conversant with the treatment for electric shock.

Reporting accidents

56. Any accident, however trivial, shall be reported immediately to the Senior Authorised Person.

57. The Senior Authorised Person shall prepare a report on each accident involving injury to persons or damage to equipment for submission to the Group Engineer or Chief Engineer, as appropriate.

Appendix 3

Department of Health
and Social Security

November 1970

Welsh Office

CI/SfB
41 / (62) / / (E2g)

PERMIT TO WORK/TEST FOR HIGH VOLTAGE SYSTEMS

1

Appendix 3 of Hospital Technical Memorandum No. 21

BEFORE WRITING OUT A PERMIT

Enter details in Log Book
Alter the Mimic Diagram
Isolate the system where necessary
Fix padlocks where necessary
Fix the earth connections
Fix DANGER notices
Fix CAUTION notices
Spike cables where necessary

For use at.....

RULES FOR ISSUE BY AUTHORISED PERSON (see paragraphs 14–21 of Rule Book).

WHEN YOU ARE SATISFIED THAT IT IS SAFE TO WORK OR TEST

MAKE OUT PART I OF THE PERMIT AND ISSUE THE ORIGINAL TO THE COMPETENT PERSON IN CHARGE OF THE WORK OR TEST. RETAIN THE COPY IN THE PERMIT-TO-WORK BOOK. BE SURE THAT THE COMPETENT PERSON SIGNS THE DECLARATION ON PART **2** OF THE PERMIT.

WHEN THE WORK OR TEST IS COMPLETED OR SUSPENDED

BE SURE THAT THE COMPETENT PERSON SIGNS THE DECLARATION ON PART **3** OF THE PERMIT.

SATISFY YOURSELF THAT IT IS SAFE TO MAKE THE AFFECTED PARTS 'LIVE' OR IF THE WORK IS SUSPENDED THAT IT IS SAFE TO LEAVE THE WORK SITE UNATTENDED.

CANCEL THE PERMIT BY SIGNING THE DECLARATION ON PART 4.

DESTROY THE ORIGINAL OF PART I.

ENTER DETAILS OF SWITCHING ETC. IN THE LOG-BOOK, ALTER THE MIMIC DIAGRAM AND CARRY OUT ANY NECESSARY SWITCHING OPERATIONS.

RETURN THE PERMIT BOOK, THE LOG-BOOK, AND SWITCHGEAR KEYS TO THE MIMIC DIAGRAM CABINET AND LOCK IT UP.

CARBON COPIES MUST NOT BE REMOVED, EVEN WHEN THE PERMIT-TO-WORK IS CANCELLED BEFORE ISSUE.

NOTE

Permit-to-work will be supplied in book-form, each Permit being serially numbered and comprising four parts. There are two copies of Part I (an original and a carbon copy) and Parts **2**, **3** and 4 which should be printed on the reverse side of the carbon copy of Part 1.
The original of Part 1 will be perforated for easy removal.

PERMIT-TO-WORK/TEST
(ORIGINAL)

Form No. ENG. 250

Serial No.

PART I

Issued to _____

I hereby declare that it is safe to work on/test* the following high voltage apparatus which is 'dead', isolated from all 'live' conductors and is connected to earth: _____

_____

_____

ALL OTHER APPARATUS IS DANGEROUS TO WORK ON

The system is isolated at _____

_____

The system is earthed at _____

_____

DANGER notices are posted at _____

_____

CAUTION notices are posted at _____

_____

Other precautions taken are _____

_____

The following work shall be carried out _____

_____

_____

NO OTHER WORK SHALL BE CARRIED OUT

Other Permits-to-work in use are _____

*Delete as applicable

Signed _____ Authorised Person Time _____ Date _____

PERMIT-TO-WORK/TEST

PART 2 **RECEIPT**

I hereby declare that I accept responsibility for carrying out the work on the apparatus detailed on this Permit-to-work and that no attempt will be made by me or by the men under my control to work on any other apparatus.

Signed _____ Status _____

Time _____ Date _____

PART 3 **CLEARANCE**

I hereby declare that the work for which this Permit-to-work was issued is now suspended/completed* and that all the men under my charge have been withdrawn and warned that it is no longer safe to work on the apparatus specified on this Permit-to-work and that all gear, tools, etc. have been removed.

Signed _____ Status _____

Time _____ Date _____

PART 4 **CANCELLATION**

This Permit-to-work is hereby cancelled. The original has been returned to me and destroyed in the presence of the signatory to Part 3.

Signed _____ Authorised Person

Time _____ Date _____

*Delete as applicable.

Appendix 4

Mimic Diagram cabinet and Key locker

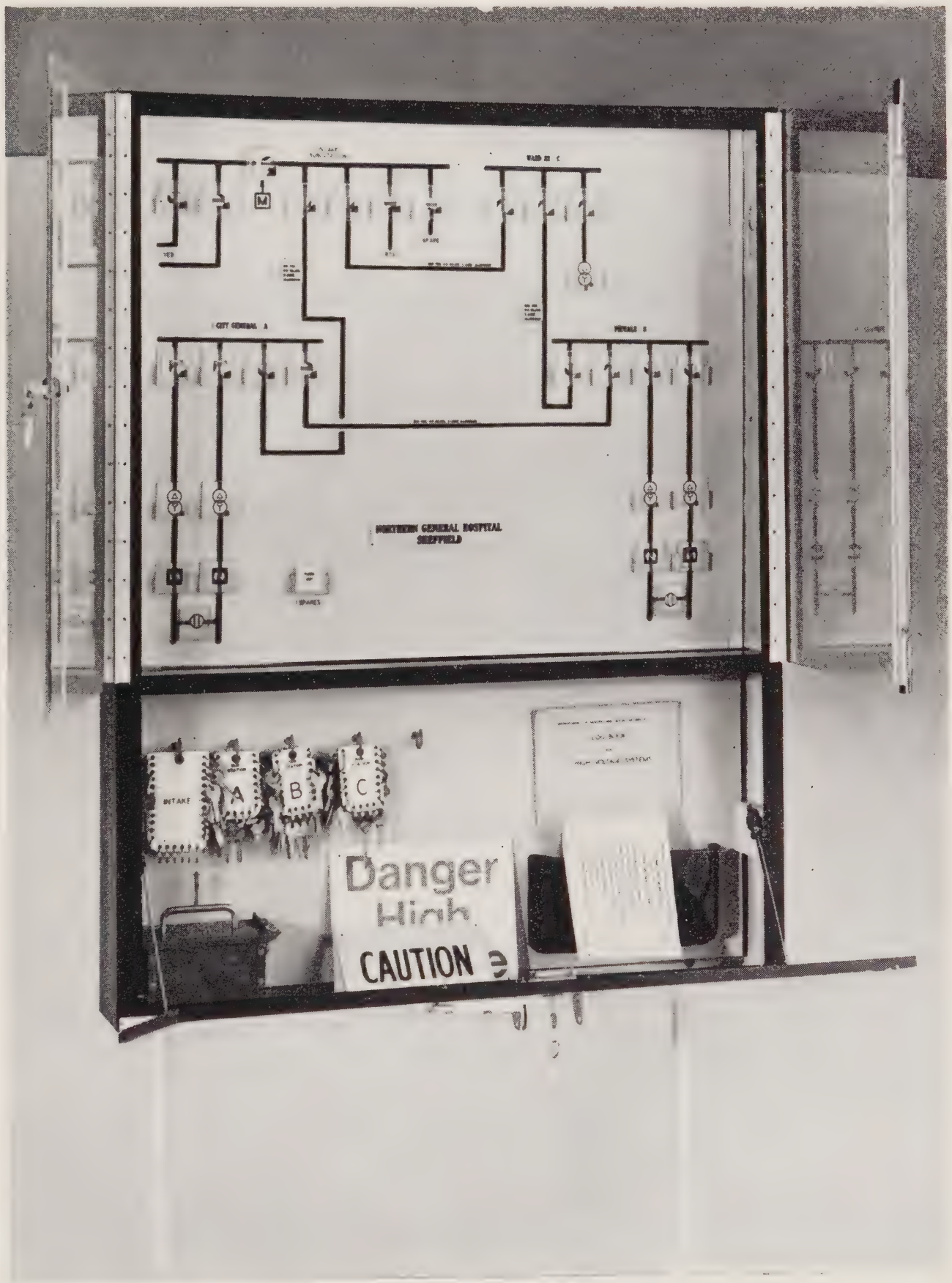
1. The mimic diagram should consist of a single line circuit showing the whole of the H.V. system and also the M.V. circuits that can feed back to the H.V. circuits. Each switch, circuit breaker and transformer should have facilities for indicating whether the switching contacts are closed, open, or earthed.

2. The cabinet should contain a locker which will contain the keys of all the safety locks associated with the system. The keys for each distribution centre should be on a separate bunch, clearly labelled to correspond with the labelling of the centre on the diagram.

3. The Mimic Diagram cabinet should be equipped with a "Work on H.V. System in Progress' notice, so arranged that it can only be shown by an Authorised Person having a key to the Key locker.

4. The Log-book and Permit-to-work book should be kept in the Key locker when not in use.

5. Figure 1 shows a typical Mimic Diagram cabinet and Key locker.



Mimic Diagram and Key Locker **Fig. 1**

Appendix 5

Training of Authorised and Competent Persons

1. It is important that staff selected for training as Authorised or Competent Persons should have the necessary basic technical knowledge.

2. Training should include attendance at appropriate short courses of instruction but it is equally important that those concerned should be given the opportunity of gaining practical experience by working with or under the guidance of suitably trained and experienced men. Training courses should, as far as possible, also include practical work on appropriate H.V. equipment.

3. The training syllabus should include:

(*a*) Electricity Regulations

(*b*) Procedure for initiating work: the Permit-to-work system.

(*c*) H.V. switchgear.

(*d*) Distribution systems.

(*e*) Earthing.

(*f*) Protective equipment and circuits, fault current calculations.

(*g*) Instructions on special test equipment, including secondary injection testing.

(*h*) Arrangements for stand-by supplies.

(*i*) Servicing and maintenance.

(*j*) First-aid, including demonstrations and practice of procedures.

Appendix 6

Safety equipment

1. The Electricity (Factories Act) Special Regulations No. 24 states: "Portable insulating stands, screens, boots, gloves, or other suitable means shall be provided and used when necessary adequately to prevent danger, and shall be periodically examined by an Authorised Person".

2. The following safety equipment should be provided and stored so as to be safe from unauthorised interference.

(*a*) ***In each Regional Board Area****

1 No. 5000V insulation tester.
1 No. Secondary injection test set.
1 No. Underground cable tracer.
1 No. Cable spiker (preferably cartridge fired type).
1 No. H.V. voltage test rod, with adaptors for "phasing out".
1 No. H.V. test rod verifying unit.

(*b*) ***In each Group*** (H.M.C. or B.G.*)*:

1 No. H.V. voltage test rod.
1 No. H.V. test rod verifying unit.
1 No. Set of 3 test bushes for each type of circuit breaker in the installation.

(*c*) ***In care of Authorised Person:***

1 Pr. Safety gloves (boxed in French chalk).
1 No. Heavy duty (e.g. rubber clad type) hand torch.
1 No. Key to sub-stations.
1 No. Key to key locker.
2 No. Personal padlocks and keys (no duplicates).
1 No. Copy of Memorandum on the Electricity Regulations.
1 No. Copy of Rule Book.

*It is suggested that arrangements be made for Boards of Governors to share the use of this equipment.

(*d*) ***At each main sub-station:***

1 No. Mimic Diagram and Key locker.
1 No. Copy of Memorandum on the Electricity Regulations.*
1 No. Pad of Permits-to-work.*
1 No. Key safe.*
1 No. Earthing pole.
1 Set Numbered padlocks each having a single numbered key, allowing a separate lock for each safety-controlling device at each sub-station.*

(Note: Normally two padlocks are required for each switching unit).

1 No. Log-book.*
1 No. Memo pad.*

(*e*) ***At each main and subsidiary sub-station:***

1 No. Electric shock (Resuscitation) poster.
1 No. H.V. safety regulations poster, Form No. ENG. 251.
1 No. Earth lead.
1 Set Switchgear earthing adaptors, appropriate to make of switchgear (if required).
1 Set Each type of control and indication circuit fuses (if required).
1 Set Each type of H.V. fuses (if required).
CO_2 portable extinguishers (size and quantity depending on room size).
1 No. "Turnover" auto-manual CO_2 warning sign (if required).
3 No. DANGER notices.
3 No. CAUTION notices.

(*f*) ***At a pretermined central location***

1 No. Key to sub-stations.
1 No. Key to key locker.
1 No. Log-sheet.
1 No. "Break-glass" fronted box for the above.

NOTE: Items marked * normally kept in Key locker.

Appendix 7

Department of Health
and Social Security
June 1970

Welsh Office

FORM No. ENG 251

(A copy of this Poster is to be displayed in each H.V. Substation)

HIGH VOLTAGE SAFETY REGULATIONS

FOR THE PURPOSE OF THESE REGULATIONS A HIGH VOLTAGE SYSTEM INCLUDES SWITCHGEAR, H.V. CABLES, TRANSFORMERS & MEDIUM VOLTAGE SWITCHGEAR & CABLES UP TO & INCLUDING THE FIRST ISOLATION POINT FROM THE TRANSFORMER

I GENERAL

(a) No person shall enter a Substation or High Voltage Test Enclosure unless accompanied by an Authorised Person or covered by a Permit-to-work issued by an Authorised Person.

(b) All work in a Substation or H.V. Test Enclosure shall be under the direct control of a Competent Person.

(c) All persons operating or working on an H.V. System shall comply with the Department of Health & Social Security Safety Rules for High Voltage Installations & the Electricity (Factories Act) Special Regulations 1908 & 1944.

(d) No H.V. switch shall be operated except by the Authorised Person, or under his immediate supervision, except in the event of extreme emergency when the switch may be tripped.

(e) Any accident, however trivial, must be reported to the Authorised Person.

II BEFORE COMMENCING TO WORK/TEST the Competent Person shall ensure that he understands the Permit-to-work system and:-

(a) Has received a Permit for each section of work/testing involved.

(b) Has satisfied himself that the Authorised Person has demonstrated that safe working conditions exist.

(c) Check that the Authorised Person has isolated any automatic fire extinguisher system covering the space in which work is to be undertaken.

(d) Ensure that he is familiar with an approved method of treatment for electric shock & resuscitation.

III WHILST WORKING/TESTING the Competent Person shall:-

(a) Limit the work/testing to that covered by the Permit-to-work.

(b) Ensure that he his not alone nor leaves any assistant alone whilst H.V. apparatus is being worked upon or any danger exists on the H.V. System.

(c) Ensure that when H.V. Tests are to be applied, the area containing the accessible parts, test equipment & test connections, are taped off by white tapes supported from posts to form a test enclosure. This enclosure shall be watched at all times & 'DANGER' Notices must be exhibited & be visible from all possible angles of approach.

IV ON COMPLETION OF WORK/TESTING the Competent Person shall:-

Ensure that the Permit-to-work/test has been returned to the Authorised Person for cancellation.

DEFINITIONS

(a) Authorised Person	A person appointed by the hospital authority to be responsible for any work or switching of H.V. Installations.
(b) Competent Person	A person over 21 years of age approved by the Authorised Person for the duties to be performed.
(c) Permit-to-work/test	A completed & signed offieial document H M S O form no. ENG 250.
(d) Test Enclosure	A Temporary testing area marked by white tape around conductors which are exposed for H.V. Testing. The tape shall be at least 25mm wide & arranged at about 0.85M above ground level & provide a minimum safety clearance of 2M around the exposed conductors.
(e) Danger Notice	A notice bearing the word 'DANGER' in 70mm red letters on a white background.
(f) Caution Notice	A notice bearing the word 'CAUTION' in 70mm black letters on yellow background.
(g) Apparatus	Electrical apparatus including a machine, a cable or a fitting in which a conductor is used or of which a conductor forms part.
(h) Key Safe	A small box provided to house the keys which would enable apparatus being worked on to be energised. Such boxes will have facilities for 3 padlocks.
(j) High Voltage (H.V.)	Electrical pressure exceeding 650volts.
(k) Medium Voltage (M.V.)	Electrical pressure above 250volts & up to 650volts.
(l) Safe	Capable of being touched by hand without danger

Dd. 729892 K12 10/70 WPL 466

(Appendix 7 of Hospital Technical Memorandum No 21)

Appendix 8

Department of Health
and Social Security

Welsh Office

CI/SfB
41 / (62) / / (E2g)

November 1970

LOG BOOK FOR HIGH VOLTAGE SYSTEMS

1

Appendix 8 of Hospital Technical Memorandum No. 21

For use at .....

1. All switching operations and precautionary measures taken prior to the issue of Permits-to-work should be recorded before the Permit is issued.

2. The names of all persons who are authorised to work in sub-stations or on H.V. cables should be entered in the log-book with details of the work or other reason for their presence within the risk area.

3. Telephone messages related to the operation of the H.V. system should be recorded.

Date	Time	Details of work/test or other reason for entering sub-station	Safety measures taken

Sketches or other details, telephone messages, etc.	Names of persons entering Sub-Station	Permit-to-work Number	To whom issued	Signature of Issuing Officer

Department of Health and Social Security
Welsh Office

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Hospital Technical Memoranda

1	Anti-static precautions: rubber, plastics and fabrics (revised 1968)	In prep.
2	Anti-static precautions: flooring in anaesthetising areas	Temporarily out of print, being revised
3	Fire precautions: fish fryers	*Now contained in No.* 16
4	Colour code flexible cables and cords	2½p
5	Steam boiler plant instrumentation	7½p
6	Protection of condensate systems: filming amines	5p
7	Electrical services—supply and distribution	37½p
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9	Pneumatic tube communication systems	7½p
10	Pressure steam sterilizers (revised 1968)	19p
11	Emergency electrical services	25p
12	Maintenance of buildings, plant and equipment	20p
13	Planned preventive maintenance: a system for engineering plant and services	42½p
14	Abatement of electrical interference	20p
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16	Fire precautions (revised 1969)	35p
17	Commissioning of hospital engineering services	5p
18	Facsimile telegraphy: possible applications in district general hospitals	12½p
19	Facsimile telegraphy: the transmission of pathology reports within a hospital—a case study	17½p
20	Staff location systems	10p
21	Safety code for high voltage installations	30p

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